Remarks

The Office action mailed March 5, 2007, has been reviewed and carefully considered. Applicants thank examiner Smith for the courtesy extended during the July 17, 2007, interview. A summary of the interview appears below. Claims 1, 16, 54, 55, 83, 93, 98, 100, 102, 108, and 110 have been amended. Claims 91 and 99 are now also canceled. New claims 111-115 have been added. Entry of these amendments is respectfully requested.

35 U.S.C. §112, First Paragraph, Rejections

Claims 2, 13, 16, 98 and 107 have been rejected under 35 U.S.C. §112, first paragraph, for allegedly lacking written description. It is respectfully submitted that the present amendments obviate this rejection.

35 U.S.C. §101 Rejections

Claims 1, 2, 8-10, 13, 16-18, 40-43, 54-55, 83-84, 86-89, 91, 93-95 and 98-108 have been rejected under 35 U.S.C. §101 as claiming non-statutory subject matter since they allegedly recite naturally occurring molecular motors. The examiner refers to three naturally occurring systems. The distinctions between the presently claimed motor and each of these three systems are explained below. In addition, schematic representations of the naturally occurring systems and the presently claimed motor are shown in attached Exhibit 1.

The first system is the actin/myosin muscle system. The Office action on page 4 states that "[i]t is noted that rotating actin is connected to Z-disks (surface) in nature (Oplatka, page 301, col. 2, first paragraph) and M-line and cross-connections hold thick filaments (myosin) in proper array that represents myosin disposed on a surface (Ganong, page 44, col. 2, last paragraph to page 45, col. 1, first paragraph)." However, the actin/myosin system in muscle does not disclose an array of motor molecules disposed upon a surface of a cylinder, shaft or cone (wherein the cylinder, shaft or cone has a longitudinal axis) such that the surface rotates around the longitudinal axis as presently recited.

FIG. B in Exhibit 1 schematically represents the actin/myosin system in muscle. Individual actin filament rotation in shortening muscle is shown by a series of cylinders rotating

individually as implied by Oplatka. The implied rotation is around the longitudinal axis of the filament itself. The Z-disk (a "surface" according to the Office action) to which the actin filaments are attached is shown as a rectangle. If the actin filament rotates along its axis, it is because the actin filament is connected to the Z-disk via a "molecular swivel-joint" (see Oplatka, p. 301, first column). In other words, if the actin molecules rotate, they would have to rotate at their connection point to the Z-disk (see FIG. B). Thus there are many points of rotation, but the Z-disk does not rotate around a longitudinal axis. If Z-disk rotation (large arrow) occurs, it cannot be driven by the rotation of individual actin molecules. Such a large scale Z-disk rotation would twist the actin filaments, destroying the muscle. Rather, the Z-disks move laterally with respect to each other during muscle contraction (see Figure 3-5 in Ganong). Thus, this is not the same geometry as presently claimed.

The Office action also notes on page 4 "that rotation in actin and microtubule-based motility systems is stated in Oplatka (abstract))." The abstract of Oplatka reports that:

> "data is presented which suggests that the actin filaments rotate in shortening muscle. Microtubules also have been reported to rotate upon interacting with kinesin and dynein. Axial protein rotation thus appears to be a common fundamental characteristic of actin- and of microtubule-based motility systems."

It is apparent that Oplatka is describing rotation of individual molecules around the longitudinal axis of the molecule itself. Put another way, the axial rotation of the molecule itself occurs in a rotational direction that is perpendicular to the directional alignment of the molecule. In contrast, the rotation recited in the presently pending claims relates to the rotation of a surface upon which the molecules are disposed.

Moreover, according to dependent claim 111, the motor molecule itself rotates in a direction that substantially parallels the directional alignment of the motor molecule. Similarly, according to dependent claim 113, rotation of the second surface or the curved surface is in the same direction as the directional alignment of the first motor molecule and the second motor molecule. For example, FIG. 1 of the present application depicts directional arrow 32 for actin molecule 30. Directional arrow 32 is in the same rotational direction as arrow 22 which shows the rotation direction of the actin molecules disposed upon the outer surface of inner cylinder 12.

FIG. D of Exhibit 1 also depicts an example of the geometry of presently pending claims 1 and 83. The small curved filament represents an actin filament. The large cylinder has a myosin-coated surface. As depicted by the large arrow, the actin filament moves in the direction of its long or directional axis.

Claim 1 further specifies that the second motor molecule is directionally aligned substantially perpendicular to the longitudinal axis of the surface upon which the second motor molecule is disposed. In sharp contrast, assuming *arguendo* that the Z-disk and the M-line cross-connections have a longitudinal geometric axis (they do not have a rotation axis), the actin filaments and the myosin filaments in muscle are directionally aligned substantially parallel to such axis.

Furthermore, dependent claim 104 states that the second surface is rotatable in a rotational direction that substantially parallels the directional alignment of the second motor molecule (see, e.g., the figures in the present application). Neither the surface of the Z-disk nor the surface of the M-line cross-connections rotates in a direction that substantially parallels the direction alignment of the second motor molecule.

The second system is the F_1-F_0 ATPase system mentioned on p. 257, column 1 of Thomas et al. (citing Noji et al, 1997 Nature 386, 299-302 (copy enclosed as Exhibit 2)). The F_1-F_0 ATPase system is schematically represented in FIG. C of Exhibit 1. This motor consists of a shaft (F_1) passing through a bearing (F_0) (see Fig. 1a in Noji et al.). The rotation occurs internally within a single molecule (see Noji et al. abstract – "We now show that a **single** molecule of F_1-ATPase acts as a rotary motor" (emphasis added)). The F_1-F_0 ATPase motor does not include a first array of a first motor molecule, a second array of a second motor molecule, a first surface, or a second surface as presently claimed. Furthermore, individual F1-F0 ATPase molecular motors cannot be joined together to create a single large rotation.

The third system is the DNA rotary motor mentioned on p. 257, column 1 of Thomas et al. (citing Doering et al., 1995 Biophysical Journal 69, 2256-2267 (copy enclosed as Exhibit 3)). As shown in FIGURE 1, a DNA molecule threads through a portal orifice meaning that the geometry of the DNA motor is also the same as FIG. C of Exhibit 1.

35 U.S.C. §112, Second Paragraph, Rejections

Claims 1, 2, 8-10, 13, 17-18, 40-43, 91, 93-95, 104, 107, and 108 have been rejected under 35 U.S.C. §112, second paragraph, for alleged indefiniteness associated with "directionally aligned" and "directional alignment." It is respectfully submitted that these rejections have been obviated by the claims presented herein. Applicants also point out that the application clearly explains these phrases. For example, page 13, lines 17-19 of the application teach that "[a]ctin is a directionally oriented molecule, that (when applied directionally to a substrate) helps direct myosin along a substrate in a direction determined by the orientation of the actin molecules on the surface." Referring to FIG. 1, page 18, lines 16-18, indicate that "a layer of actin 30 is directionally applied to the outer surface of cylinder 12, with the directional orientation shown as arrows in the drawing." Hence, a person of ordinary skill in the art reading the specification would fully comprehend the phrases "directionally aligned" and "directional alignment."

35 U.S.C. §102 Rejections

Claims 1-2, 8-9, 13, 16-18, 40, 43, 83-84, 86-89, 91, 93-95 and 98-108 have been rejected under 35 U.S.C. §102(b) over Oplatka with additional support from the Merriam-Webster online dictionary and Ganong. The Office action cites to a glass surface experiment described in Oplatka, as well as the actin/myosin muscle system discussed above in connection in the 35 U.S.C. §101 rejection. The difference between the claims presented in this response and these two systems disclosed in Oplatka is explained below in detail.

Oplatka describes an experiment in which actin filaments move over myosin molecules fixed on a glass surface. Applicants' December 29, 2005, response pointed out that the actin filaments and the myosin molecules are both disposed on the same surface (i.e., the glass surface) rather than on different surfaces as recited in the presently pending claims. The examiner replies on page 9 of the Office action that "Oplatka discloses axial rotation of actin filaments sliding over myosin molecules fixed on a glass surface with fluorophores bound to the filaments and actin filaments fixed at their front end (page 302, col. 2, third paragraph) and actin connected to Z-disks (surface) (page 301, col. 2, first paragraph)." However, there is no indication in Oplatka that that the actin filaments in the glass surface experiment were connected to Z-disks. The passage cited in the Office action regarding the Z-disks refers to the naturally

occurring muscle structure; not the glass surface experiments. Thus, the glass surface experiment did not include two separate surfaces and cannot anticipate the presently pending claims.

In addition, FIG. A of Exhibit 1 depicts the glass surface experiment. An actin filament is shown as a cylinder on a glass surface (shown as a rectangle). As shown by the arrow, the axis of actin rotation is parallel to the glass surface. In contrast, the presently recited surface or array rotates around a longitudinal rotation axis. FIG. A also clearly shows that the individual actin filament rotates rather than the glass surface upon which it is disposed.

The distinctions between the actin/myosin muscle system and the presently claimed motors are explained above in connection with the 35 U.S.C. §101 rejection. The Z-disks and/or the M-line cross connections do not, in fact, rotate around a longitudinal rotation axis as recited in the independent claims, much less an axis that is perpendicular to the directional alignment of either the actin or the myosin as recited in claim 1.

Furthermore, the motor of independent claim 16 includes a driven member moved by the directional movement of the second surface. The Office action asserts on page 7 that the actin helices represent a "driven member." However, the actin helices are the motor molecules themselves, and thus cannot be a separately claimed driven member. Moreover, the actin helices in the muscle system are not moved due to the movement of a second surface as recited in claim 16. For these additional reasons, claim 16 also is not anticipated by Oplatka.

As explained in applicants' December 29, 2005, response, in all of the systems disclosed in Oplatka the axis of rotation of the motor molecules is parallel to the longitudinal axis of the elongated motor molecules themselves (see, e.g., FIGS. A and B of Exhibit 1). In other words, the motor molecule rotates in a direction that is perpendicular to directional alignment of the motor molecule. In contradistinction, dependent claim 111 recites a geometry wherein the motor molecule itself rotates in a direction that substantially parallels the directional alignment of the motor molecule. Similarly, according to dependent claim 113, rotation of the second surface or the curved surface is in the same direction as the directional alignment of the first motor

molecule and the second motor molecule. FIG. D of Exhibit 1 emphasizes this distinction set forth in claims 111 and 113.

35 U.S.C. §103 Rejections

Claims 10, 41-42 and 54-55 have been rejected under 35 U.S.C. §103 over Oplatka combined with Nagai et al. with additional support from the Merriam-Webster dictionary. Independent claim 54 is directed to a motor that includes rotation of a surface of a cylinder, shaft or cone around a longitudinal axis defined by the cylinder, shaft or cone, wherein an array of motor molecules is disposed upon the surface. As explained above in connection with the 35 U.S.C. §§101 and 102 rejections, Oplatka does not describe any motor with such geometry. In addition, for the reasons explained in applicants' December 29, 2005, response, Nagai et al. does not compensate for this fatal deficiency in Oplatka. Accordingly, the obviousness rejection of claims 54 (and dependent claims 10, 41, 42 and 55) must be reconsidered and withdrawn.

Interview Summary

During the interview on July 17, 2007, the above-noted differences in the geometries between the three naturally-occurring motors, the glass surface experiment in Oplatka, and the presently claimed motors were discussed.

It is respectfully submitted that the application is in condition for allowance. Should there be any questions regarding this application, examiner Smith is invited to contact the undersigned attorney at the telephone number shown below.

Respectfully submitted,

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